Draft Responses to Delta Science Program Review Panel Report on BDCP Effects Analysis - November 2011

In October 2011, the Delta Science Program Review Panel reviewed early drafts of Appendix A (Conceptual Foundation and Analytical Framework) and Appendix B (Entrainment) of the Bay Delta Conservation Plan (BDCP) Effects Analysis and offered 11 major recommendations in their November 2011 report. ICF offers the following responses to each of the 11 major recommendations provided by the Delta Science Program Review Panel. Each comment is summarized, followed by a brief response to each component of the comment. These responses are based on the current state of the effects analysis as documented in the February 29, 2012, administrative draft of Chapter 5 and the technical appendices that accompany it. A revised version of Appendix B that addresses many of the panel's comments (as described below) will be released on March 30, 2012.

On February 29th, ICF submitted for review by agencies and the Delta Science Program Review Panel the administrative draft of BDCP, including Chapter 5 and many of its revised appendices. Based on agency and Science Panel input, ICF will revise the effects analysis and circulate it, along with the other chapters of the BDCP, for public review and comment (Public Draft of the BDCP). The Public Draft is expected to be released in June 2012.

Recommendation 1: Goal of Effects Analysis needs to be clearly defined.

- Analysis should describe the impacts of conservation measures, singly and interactively, on the Bay-Delta ecosystem as a whole.
- Analysis should demonstrate better understanding of Delta ecology at both the community and ecosystem levels including the food web and including effects of processes such as hydrology and sedimentation.
- The goal of the framework/analysis should be to "understand the potential cumulative effects of the conservation actions within the BDCP on the covered species and Bay-Delta ecosystem".
- The Effects Analysis will likely have considerable uncertainty.

Response: ICF concurs with the recommendations. As we were working on the first draft of Chapter 5, it was apparent that the components of Appendix A were either repetitive of other chapters (i.e., background information in Chapter 1) or that it was better suited in Chapter 5, where it could better frame the net effects discussion, including methods for evaluation and the discussion of landscape and ecosystem changes. For this reason, we have eliminated Appendix A and have moved much of the material into Chapter 5 of the administrative draft and the other appendices. In doing so, we have incorporated the recommendations from the Science Panel as best we can. The purpose of the net effects analysis in Chapter 5 is to evaluate the effects of the conservation measures individually and cumulatively. Because the major topics of interest are divided in the appendices, the cumulative effects of all BDCP actions are not readily apparent in

the appendices. However, these effects are integrated into the net effects discussions in Chapter 5 to provide a holistic description of how these measures interact with each other and the ecosystem, and what the net effect on each species is. Table 1 below shows where the components of the October 2011 Appendix A may be found in the February 2012 Administrative Draft of the BDCP.

Table 1: Location of Appendix A Material in BDCP Administrative Draft

October 2011 Appendix A Topic	New Location in BDCP February 2012 Administrative Draft
Vision and Strategy	Chapter 1, Section 1.2
Biological Goals and Objectives	Chapter 5, Section 5.2
Legal and Regulatory Context	Chapter 1, Section 1.3
Relationship to other Plans	Chapter 1, Section 1.5
Conceptual Model for Effects Analysis	Chapter 5, Section 5.2
Ecological Principals and Background	Chapter 2, Section 2.3; and Chapter 5, Section 5.3
Measurements of Species Performance	Chapter 5, Section 5.2
Geographic and Temporal Structure	Chapter 5, Section 5.2
Models Used	Chapter 5, Section 5.2
Integration of Effects Approach	Chapter 5, Sections 5.2 and 5.5
Climate Change Effects	Chapter 2, Appendix C (to come)

Where possible, the effects of conservation measures have been analyzed interactively (e.g., the Delta Passage Model allows consideration of CM1, CM2, CM4 [from the perspective of habitat restoration effects on Delta hydraulics], CM15, and CM16). Inasmuch as changes in Delta geometry have been incorporated into the flow modeling, there has been some integration of habitat restoration (in particular CM4) with the analyses that rely on Delta hydrodynamic modeling. Likewise, the physical modeling incorporates sea level rise and other climate change factors that allow the analysis to show the individual effects of the Preliminary Proposal as well as the cumulative effects under future climate change conditions. In contrast, conservation measures that affect stressors such as predation, illegal harvest, submerged aquatic vegetation, and toxins generally can only be evaluated qualitatively, but are integrated into the net effects analysis in Chapter 5 to demonstrate how they might interact and what effect that would have on each species. As part of our net effects analysis in Chapter 5, we have included 'certainty scores' to clearly articulate the level of certainty we have in both the importance of a potential stressor on each species and the certainty of our analysis. It should be noted that at this time the stressor and certainty ratings represent only ICF's evaluation, which has not yet been vetted with have not been discussed with the fish agencies; it is our intent to do so prior to the public draft BDCP.

Recommendation 2: The Framework appendix needs to follow a logical flow and provide a "road map" indicating how the Effects Analysis will build toward the overall goal.

- Appendix A should be reorganized.
- Provide a roadmap that shows how the analytical framework is to be used to guide the Analysis and how each of the appendices relates to the conservation measures.
- Clarify how the synergistic effects of individual conservation measures will be treated in the "roll-up".
- The Effects Analysis is an important part of the logic chain and analysts should clearly lay out the linkages among logic chains, effects analysis, implementation, monitoring, research components, and adaptive management.

Response: As discussed above, Appendix A has been eliminated and much of the information has been incorporated into Chapter 5. Though it does not appear in the current version of Chapter 5 in the Administrative Draft, it is our intent to develop the road map linking the analytical framework to the effects analysis. That road map should include the linkages between the measures, the analysis, implementation and adaptive management. The Panel's comments on incorporation of synergistic effects in the "roll-up" will be discussed below.

Recommendation 3: The analytical framework should define the nature and structure of the integration of results (a.k.a., "roll-up") and how the overall assessment of the efficacy of the plan will be determined. This integration should be summarized by individual species.

- The term "roll-up" is not clear. Use the term "integration of results" instead.
- Consultants should develop one draft "integration of results" (aka roll-up) for one species and submit this to the Panel for review ASAP.
- Analytical Framework should provide an explicit roadmap of how the integration of results will be developed and how the information will be synthesized into an overall assessment of the impacts on listed species.
- The qualitative methods described in Appendix A for assessing the impacts of stressors and enhancers are insufficient for determining the cumulative impacts of BDCP.
- In cases with insufficient information, there needs to be a common currency to compare impacts.
- Consultants are encouraged to develop species models (with simple population metrics), with assumptions and uncertainties described, to aid in the assessment of cumulative and synergistic impacts.
- Table B-254 is not an effective way to display result of Appendix B. Instead, consider summarizing results for each species and discussing how these overall effects will interact with each other.

Response: We are using the term "net effects" to describe the conclusions regarding the sum total of adverse and beneficial effects of BDCP on each covered species (instead of "roll-up"). The methodology for the net effects section is described in Chapter 5, including clear references to the results from appendices and how they are used to determine the net effects.

The integration methodology for net effects that is described in Chapter 5 provides a multi-species and multi-ecological functions analysis of BDCP. It is built on an analysis of effects for individual species and for ecological functions such as the delta food-web. It is a qualitative ranking system that incorporates results from both qualitative and quantitative analysis of individual measures and provides conclusions regarding "certainty" of the underlying science. This approach is necessary because there is no over-arching quantitative model available to integrate effects across life histories of different species and to accommodate the range of qualitative and quantitative analysis.

Regarding the qualitative methods used to assess the impacts of stressors, in many cases these are the only approaches available for determining effects on BDCP. In other cases such as illegal harvest or predation, even if quantitative models existed and were well accepted, there is insufficient data with which to predict the effects of BDCP. Because the regulatory standard is "best available science," the use of qualitative analytical methods is appropriate for the effects analysis. Additional quantitative models could be developed and applied during plan implementation to further refine and verify the predictions of BDCP effects.

Per the recommendation, we will be developing simple species conceptual models that will be included in the revised accounts for the aquatic species (Appendix 2-A in the public draft) to help guide the effects analysis. We are also revising Table B-254 to more effectively illustrate the results of the entrainment analysis and other similar analyses. Additionally, we have included summary tables that clearly link the results in the text to the results in the tables in the Flow, Passage, Salinity, and Turbidity Appendix (C). These tables help to quickly identify the results of the large volume of modeling data.

Recommendation 4: The Panel believes the fundamental currency of the Effects Analysis should be species population viability.

- Population viability criteria (abundance, population productivity, genetic and phenotypic diversity, population spatial distribution) should be used to evaluate project effects on species.
- The scale of the Effects Analysis should be at the population level.
- Critical assumptions and uncertainties in the methodology should be clearly identified and presented in the effects analyses.
- Appendix B should consider error propagation which can result from the tradeoff in certainty between local and population scales.
- In Appendix B examine additional viability criteria among Chinook salmon.

- In Appendix B evaluate size-at-age of entrained salmon as a means to consider entrainment of various life history types. Hatchery salmon should be evaluated separately from natural origin salmon.
- Misclassification of entrained spring Chinook as fall Chinook would have a significant error when assessing the impact on spring Chinook salmon.
- A sensitivity analysis could facilitate the evaluation of uncertainty.

Response: We agree with the recommendation. However, currently available lifecycle models are limited in number, and limited in their ability to assess the population level effects of suites of conservation measures such as contained in BDCP. At present, many of the models available are limited in their ability to integrate new configurations of the Plan Area (i.e., Delta) and therefore are limited in their application to predicting effects of the BDCP. Nonetheless, population viability criteria were used and described in Chapter 5 to help support the net effects analysis and to provide a common approach to evaluating the covered fish species. The net effects analysis evaluates effects on species and not to the level of genetically based populations such as those that have been identified for salmon in the Central Valley. Population structure has not been defined for most delta species such as delta smelt. For salmon, our intent has been to evaluate effects to salmon behavioral types (i.e., ocean versus stream type behavior) and to runs (i.e., fall or winter runs). Often, data are lacking on baseline population levels or effects of key stressors on populations. Critical assumptions and uncertainties in the methods are described, and the certainty of both the analysis and the importance of each stressor analyzed is scored and documented as part of the net effects analysis.

With respect to subdivision of Chinook salmon juveniles into sizes and hatchery-origin salmon separate from wild salmon, we will defer decisions on these matters to California Department of Water Resources (DWR) as they originally supplied the salvage data upon which the salvage-density method (presumably the main method to which the panel is referring) was based; division of the species into these subgroups would require reprocessing of the salvage data and could take considerable time, and not all hatchery fish are marked. We acknowledge the potential misclassification of spring-run and fall-run Chinook salmon, an important point also noted by National Marine Fisheries Service (NMFS) who suggested that genetics information kept by DWR could be used to inform the division between races. Our inquiry to DWR to follow up on this suggestion revealed that the information is not yet available and there is limited accuracy for assigning run identity of some stock.

We are currently pursuing sensitivity analyses for key methods such as the Delta Passage Model and will incorporate them into the effects analysis when they are available.

Recommendation 5: The framework should use all available best science and describe why other current science was excluded and provide justification for the exclusion.

- Exclude models or techniques that are less credible via a screening process that weights model results based on the strength of evidence, robustness of conclusions, and relevance of model results to population-level effects.

Response: ICF concurs with the Panel's recommendation that alternative models and methods provide valuable means of assessing the robustness of conclusions, and that the universe of models and methods should be limited to those that are reasonable. In the course of the initial review, it became clear that our judgment differed from that of the state and federal agencies. In the interest of transparency and to be sure that all models and methods used in the effects analysis are fully vetted, the current draft effects analysis retains several methods that we earlier sought to exclude. We are continuing to work with the agencies to ensure that the best available science is identified and used in the effects analysis.

Recommendation 6: The Effects Analysis needs to build on an already well-populated ecological context.

- The ecological principles (from Appendix A) should be incorporated into and referred to within each of the detailed appendices.
- The analytical approach in Appendix B should vary the temporal dimension.
- Since focused modeling of a single species may lack sufficient detail to predict future population changes, it is important to recognize community-level trophic, mutualistic, and other interactions among species. Even simplified models may provide insight into the actual overall impact of BDCP.
- To consider effects of the BDCP on the broader Delta and Bay ecosystems, provide a comprehensive perspective about the greater food web and other ecological interactions (e.g., wetland, detritus-based) affection declines in salmon and other Delta biota.
- ESA listed salmon are vulnerable to hydrological changes and wetland losses and they have an unknown response to BDCP actions. This should be a critical subject of the HCP.
- A rationale for expanding the ecological scope, landscape scale, and temporal scale of the Effects Analysis is that salmon represent at-risk populations that are tightly linked to wetland, detritus-based food webs and rear in lower floodplain and tidal regions of the Delta.
- Provide a comprehensive description of anthropogenic changes in the Delta watershed by describing historical hydrology and sources of change relative to unaltered historical patterns.
- Expand the description of effects of predictable future conditions to include anthropogenic drivers such as water, land, and sediment supply (i.e., expand Figure A-8).

Response: We will consider referencing and incorporating the appropriate ecological principles listed in Appendix A in the appropriate subsequent technical appendices. We are unsure what is referred to by the Panel's comment (p. 17) '[Appendix B] did not seem to vary the temporal dimension.' Presumably, this refers to the timescale adopted for analysis. Analyses in this appendix were generally based on underlying analyses at the daily (DSM2), monthly (CALSIM), or multi-monthly/annual (CALSIM-derived analyses such as delta smelt proportional entrainment regressions) timescale. As the panel noted, the results were occasionally summarized by water-year type. The effects analysis considers community-level trophic, mutualistic, and other interactions among species based on available literature and best professional judgment. The effects of BDCP on food production and food webs, including through detritus-based wetlands, are discussed in Appendix E: *Habitat Restoration* and in Chapter 5; these effects are discussed at multiple scales. Chapter 2 provides a comprehensive description of anthropogenic changes in the Delta watershed; this description will be better cross-referenced in the appendices.

Recommendation 7: Adaptive management needs to be an explicit process in the Effects Analysis to deal with fundamental uncertainties.

- Identification of uncertainty in project outcomes during the Effects Analysis stage of conservation planning can be an important tool for achieving program objectives.
- Uncertain outcomes should be accompanied by a more rigorous monitoring program.

Response: ICF has more explicitly incorporated adaptive management in the effects analysis, including statements on key uncertainties that should be addressed with focused monitoring. Additionally, as described above, the certainty of a stressor's importance on each species as well as the certainty of our analyses are 'scored' in Chapter 5 to provide readers with a sense of the level of certainty for the net effects. The linkage between the effects analysis and adaptive management will be strengthened further for the public draft. One example of this will be for effects related to water operations. The Department of Water Resources is developing a proposal for "adaptive limits" for water operations. Adaptive limits will define alternative water operations (e.g., a block of water available) that could be used through the adaptive management process if the biological goals and objectives for covered fish were not being met. The effects analysis does not evaluate the benefits of adaptive limits for covered fish but will do so for the public draft.

Recommendation 8: The Effects Analysis needs to address temporal and spatial scales more comprehensively and appropriately.

- The order and timing of the conservation acts could have an effect on the overall benefits of the Plan to a covered species.

- A sensitivity analysis is recommended to assess the effects of order and timing of conservation acts on species responses to the Plan. Any time-critical or order-sensitive conservation acts should be identified and prioritized.
- The timing, frequency, and magnitude of the conservation actions need to be explicitly developed. For example, predator control and submerged aquatic vegetation removal should have a defined frequency and magnitude for their implementation.
- In aquatic systems like the Delta, flow rates of water, nutrients, and levels and duration of salinity all combine to encompass the limits of particular species. Organisms respond to this pattern of processes within temporal and spatial dimensions.
- Different conservation actions may synergistically enhance or cancel their individual effects, and assessment modeling needs to incorporate multiple actions simultaneously.
- Species and abiotic/biotic processes interact over various spatial scales. This interaction should be clearly framed in conceptual models and evaluated in numerical models, monitoring or targeted special studies.
- Alternative designs and operations of water export in the north Delta have potentially extensive and cumulative far-field effects to multiple conservation actions lower in the estuarine gradient.
- Be proactive in assessing the realistic timeframes expected for ecosystem responses, especially given the prognosis for significant future changes in many natural forcing factors (e.g., wetland restoration will take much longer than the 50-year timeframe of the Effects Analysis).

Response: ICF concurs that the timing and sequence of implementation of the conservation measures matters to the effects analysis. An optimal timing and sequence of the conservation measures has been considered in the design of the implementation schedule (see Chapter 6 for the description of this schedule). This design is intended to both maximize beneficial effects and to ensure that conservation benefits accrue prior to the adverse effects of the Plan, to meet regulatory requirements. The effects of implementation timing and sequence will be considered in the subsequent appendices and in the net effects analysis in Chapter 5.

A sensitivity analysis on this timing and sequence would be beneficial but is not feasible before Plan completion; this analysis could be performed during early implementation to refine the implementation schedule. We also concur that effects likely interact when combined. We are evaluating these interaction effects to the extent possible given model and information limitations in the analysis. Because of these limitations, evaluations of interaction effects will necessarily be qualitative. These interaction effects of implementing multiple conservation actions will also need to be explored and assessed in implementation as part of the adaptive management and monitoring program. Targeted research should be directed at these possible interactive effects. We also concur that the effectiveness of restoration efforts will take decades to develop and realize, potentially extending well beyond the 50-year permit term. Funding will be provided for management and monitoring in perpetuity to ensure that the restoration projects

continue to improve and provide the functions they were intended as articulated in the biological goals and objectives.

Recommendation 9: Analyses of the individual actions need to be scaled to an integrative analysis that includes all relevant conservation measures of the 19 possible.

- Appendix B should more carefully consider the effects of other conservation measures that are occurring simultaneously (and vice versa).
- Appendix B should provide a more robust description of entrainment in the proposed new North Delta facility.
- Provide a better description of how changes in the overall Delta geometry configuration were incorporated into DSM2 to model hydrology under future conditions.
- Clarify how water export operations and intra- and interannual variability of environmental conditions are taken into account cumulatively.
- Provide a table or interaction matrix that illustrates the relevant conservation measures that should logically be included for each individual (appendix) analysis.

Response: ICF concurs that a table summarizing the analyses relevant to each conservation measure would be appropriate. Table 5.2-3 lists the measures evaluated in each appendix. Specific to Appendix B, but also relevant to other appendices, we have attempted to include more consideration of the effects of other conservation measures on the results, including utilization of tools that account for several conservation measures simultaneously, while noting that certain of the methods are based on the current configuration of the Delta and will not adequately address potential changes in distribution that may affect susceptibility to entrainment and other Plan-related stressors. As noted by the panel as well as agency scientists, a more robust north Delta entrainment/impingement analysis is necessary and we are in the process of doing so.

We agree that a better description of assumed changes in Delta configuration is necessary to enable readers to understand modeling better and will work to provide such a description as part of a detailed description of CALSIM/DSM2 (Attachment A of Appendix C). At present, the cumulative (interannual) effects of water export operations are treated only in life cycle modeling (discussed in Appendix G) and the modeling tools available do not provide for quantitative evaluation of cumulative effects. However, the individual effects described in each appendix are considered as part of the net effects discussion to provide a qualitative cumulative assessment of the conservation measures on each covered fish species, including how conservation measures may interact with each other. In response to agency comments, more analysis of cumulative entrainment effects on different life stages within the same year will be undertaken for delta smelt based on proportional entrainment loss regressions.

Recommendation 10: Factors used in model evaluation (e.g., Table A-11) should be expanded to consider the robustness of the model results and the proximity of the model predictions to population level effects.

- A sensitivity analysis should be performed to determine the robustness of the Plan's outcomes under a range of model assumptions, environmental conditions, and performance.
- Models and methods that make inferences to the growth rate and viability of Delta populations should be given more credence than methods that make inferences only to specific life stages, migration processes, or subpopulations (i.e., use a hierarchical weighting system).

Response: ICF concurs and will add the recommended factors to those considered when evaluating multiple models. We also concur that a sensitivity analysis would be helpful to evaluate the robustness of the effects analysis predictions. Although this approach is not feasible in the project timeline, it could be performed during plan implementation to help refine the plan's predictions and improve the adaptive management process. We also concur that models that make inferences to growth rates and population viability should be prioritized. However, to our knowledge there are no models currently available for the covered fish that estimate these parameters. Such models may be under development and available later for use in BDCP.

Recommendation 11: More detail and specifics need to be incorporated into the descriptions of hydrodynamic and other physical model structure, calibration, assumptions, uncertainties, etc.

- Explicitly state the method of deriving the flow field for each environmental model.
- Explicitly incorporate changes in external forcing factors affecting flow (e.g., reservoir discharges).
- Describe how models (DSM2 and CALSIM) were set-up, including provision of figures of the geometric configurations for the run and reference to a calibration document.
- Approximating OMR flows using a 50% estimation is a big assumption. The flow split could be better estimated using DSM2 runs or observational data in the region.
- Overall, there needs to be better documentation of models and their underlying assumptions and known limitations.
- Panel recommends independent peer review of all models used for the appendices by experts in those fields.

Response: ICF has been describing all of the model inputs, assumptions, and limitations in the appropriate technical appendix rather than in Appendix A. For example, specific assumptions for CALSIM and DSM2 are described in Attachment A of Appendix C. We will address the specific comments provided in the appropriate appendix. We are investigating the comment about the assumption regarding OMR flows. Regarding peer review of the models, many of the models have already undergone peer review as part of the publication process (e.g., longfin smelt X2-abundance regression), or through model development by a state or federal agency (e.g., OBAN). Additionally, ICF, along with DWR and other agency staff are working together to

review and validate other models such as the Delta Passage Model. The Habitat Conservation Plan (HCP) and Natural Community Conservation Plan (NCCP) process requires that we utilize the best available science; an independent peer review of models used is not required.